Falsifiability and Prediction Table for Emergent Filament-Based Framework

Abstract

We present a structured falsifiability and empirical prediction table for the emergent filament-based theory of spacetime, quantum mechanics, and gauge symmetries. Each emergent structure is linked to its derived formula, parameters, empirical consequences, and explicit falsifiability conditions.

1 Emergent Gravity Sector

Derived Quantity	**Expression**	**Parameters**	**Empirical Prediction**	**Falsifiability Condition**
Gravitational Constant G_{induced}	$\frac{36\pi}{\log\left(\frac{T}{2A}\right)}$	Filament tension T, rigidity A	Value of Newton's constant G	Discrepancy with measured G
Cosmological Constant Λ_{induced}	$\frac{1}{32\pi^2\ell_f^4}$, $\ell_f = \left(\frac{2A}{T}\right)^{1/3}$	Same	Observed small value of Λ	Mismatch with cosmological observations
Higher Curvature Terms	$\mathcal{O}(\ell_f^2 R^2)$ corrections	Filament scale ℓ_f	Deviations from GR at high curvature	No observed deviations in strong gravity regimes

2 Emergent Gauge Sector

Derived Quantity	**Expression**	**Parameters**	**Empirical Prediction**	**Falsifiability Condition**
Gauge Groups	$\mathfrak{u}(1), \mathfrak{su}(2), \mathfrak{su}(3)$	Topological invariants: winding, linking, triple linking	SM gauge group structure	Failure to recover correct group symmetries
Gauge Coupling Constants g	(To be derived) dependent on filament linking density	Filament density and topology	Values of $g_{\text{U}(1)}, g_{\text{SU}(2)}, g_{\text{SU}(3)}$	Discrepancy with SM coupling constants
Field Strengths $F_{\mu\nu}$	Local linking/twisting density tensor $\mathcal{L}_\mu$	Local filament configuration	Observable gauge boson dynamics	Absence or deviation of gauge fields

3 Emergent Quantum Mechanics

Derived Quantity	**Expression**	**Parameters**	**Empirical Prediction**	**Falsifiability Condition**
Hilbert Space Structure	From filament mode quantization	Tension T, filament vibrational modes	Quantum mechanical behavior	Breakdown of quantum coherence predictions
Effective $\hbar_{\text{eff}}$	$\frac{T\ell_f^2}{c_\phi}$	Tension T, scale ℓ_f, wave speed c_ϕ	Value of Planck constant $\hbar$	Discrepancy with observed $\hbar$

4 Filament Structure and Parameters

Parameter	**Derived from**	**Interpretation**	**Falsifiability Condition**
Tension T	Filament dynamics	Fundamental scale setting gravitational coupling	Cannot match G or $\hbar$
Rigidity A	Filament stability and topology	Determines filament scale ℓ_f	Inconsistent with Planck scale or Λ
Filament Scale ℓ_f	$(2A/T)^{1/3}$	Minimal length scale, sets UV cutoff	No evidence of minimal length scale effects

5 Overall Falsifiability Strategy

- Metric Degeneracy: If co-metric is not invertible at generic points $\Rightarrow$ Falsified.
- Foliation Failure: If no integrable time surfaces exist $\Rightarrow$ Falsified.
- Gauge Group Failure: If topological invariants fail to generate SM gauge groups $\Rightarrow$ Falsified.
- Gauge Field Absence: If no field strengths emerge from filament topology $\Rightarrow$ Falsified.
- Wrong Coupling Constants: If induced couplings disagree with observed SM values $\Rightarrow$ Falsified.
- Vacuum Energy Mismatch: If Λ_{induced} does not match observed cosmological constant $\Rightarrow$ Falsified.

References

Placeholder for references.